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1232-139 In Vitro Validation of an Automated Method Based on Color Doppler Imaging for Determination of Flow Volume in the Presence of Nonflat Velocity Distributions

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Determination of flow volume (FV) using pulsed wave Doppler registrations is based on the assumption of a flat velocity profile which is frequently not fulfilled in the flow region of interest. To examine whether an automated method which takes into account the velocity profile in the color Doppler image enables reliable measurements of FV in the presence of nonflat velocity distributions various flow conditions were simulated in a pulsatile flow model. FV of up to 90 ml were applied through a tube with a diameter of 3 cm and circular-shaped obstructions with diameters between 0.5–2.0 cm. Furthermore, sector-type and segment-type obstructions were inserted to create nonflat velocity profiles. Determination of FV was based on rotational integration of digital color Doppler flow velocities detected across a sampling box located proximal to the obstructions. Parabolically-shaped velocity profiles were delineated by the Doppler method in the flow convergence region of the circular orifices and an excellent agreement with actual FV was found for each orifice size (r = 0.98, SEE = 0.8–2.6 ml). Skewed velocity curves were detected proximal to the segment/sector-type obstructions. Under various flow conditions, a close correlation with true FV was present with a maximal underestimation <10%.

Conclusion: An automated color Doppler method for determination of FV yields reliable measurements in the presence of nonflat velocity profiles. The method may be of particular usefulness for the assessment of prestenotic FV in valvular stenoses.

1232-140 Comparison of Automated Stroke Volume Evaluation for Determination of Valve Orifice Area by the Continuity Equation With the Conventional Approach in Aortic Stenosis

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We compared the accuracy of a color Doppler method for automated determination of prestenotic flow volume and application of the continuity equation with the conventional approach in predicting orifice area (AVA) in AS. Doppler/echo and invasive measurements were performed in 30 patients with AS. Pre- and intrastenotic velocities were recorded by PW and CW Doppler and LVOT area was measured by 2D-echo. AVA was calculated according to the continuity equation using the peak velocities as well as the integrals under the velocity curves. For the employment of the automated approach a sampling rectangle was positioned across the LVOT to analyse the velocity profile and to evaluate SV by spatio-temporal integration of the velocity curves. AVA was then calculated as SV divided by the integral under the stenotic jet velocity curve.

AVA derived from the application of the conventional approach correlated close with invasive data (r = 0.87 and 0.84, SEE = 0.19 and 0.27 cm^2 for peak velocities and velocity integrals, resp.). There was also a close correlation between AVA determined by the employment of the automated method and invasive measurements (r = 0.87, SEE = 0.20 cm^2). No significant differences were found between the correlation coefficients of the various methods.

Conclusion: Automated determination of SV enables reliable evaluation of AVA in AS by the continuity equation with no relevant difference in the accuracy compared with the conventional approach.

1232-141 A Novel Method of Assessing Regurgitant Severity: Time and Spatial Integration of Cross-sectional Color Doppler Energy Images

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When a regurgitant volume is forced through an orifice, all of the jet volume will pass through an orthogonal imaging plane distal to the jet. We have previously shown that the angle-independent modality, color Doppler energy (CDE), correlates with flow. For a cross-sectional CDE imaging plane, recorded CDE images should yield a history of all of the particles passing through the imaging plane. Therefore, this study addressed the hypothesis that planimetered *cross-sectional* jet areas summed over the time of regurgitation should yield an estimate of regurgitant severity based upon representative volumes.

Methods: Regurgitant jets were created in vitro using a power injector over a range of volumes (25–55 mL) and flow rates (30–50 mL/s) for a total of 9 flow conditions. These jets were driven through 4 mm and 2 mm diameter orifices into a receiving chamber using a blood analog solution (aqueous glycerine solution, 3.8 cp). Cross-sectional imaging planes 4 cm distal to the orifice and orthogonal to the axis of the jet were obtained using CDE (Acuson 128XP) and recorded with constant instrument settings. Planimetered images were measured and summed off-line by computer. A representative volume was calculated by summing the product of cross-sectional area and mean intensity over time.

Results: A linear relationship between actual regurgitant volume and CDE calculated representative volume was found for both orifice sizes (2 mm: r^2 = 0.97; 4 mm: r^2 = 0.85).

Conclusions: By utilizing cross-sectional jet images, this CDE method should overcome a number of limitations inherent to traditional Doppler methods, such as errors incurred by off-angle imaging planes or out-of-plane jets. This method has the potential to allow clinical assessment of valvular regurgitant severity based upon the magnitude of representative regurgitant volumes.

1232-142 PISA and ERO Method for Quantitating Mitral Regurgitations: In Vitro Validation of a New Approach Using a Series of Velocity Measurements

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The well accepted quantification of mitral regurgitations based on the PISA method includes, for the analysis of the proximal part of the jet, a single velocity measurement (the Nyquist limit) and a single distance depending on the visual determination of the position of the regurgitant orifice. In order to improve the accuracy of this approach, we have written the classical PISA equation and the corresponding formula of the Effective Regurgitant Orifice (ERO) in a different format: Vo/Vpisa = ($Rpisa^2$/8 Do^2), $(Vo/Vpisa)^{0.5}$ = Rpisa/2.83 Do, where Vo is the jet velocity, Vpisa the considered proximal isovelocity, Rpisa the corresponding radius and Do the diameter of the regurgitant orifice. Thus, the relationship between $(Vo/Vpisa)^{0.5}$ and Rpisa is linear with a slope equal to 2.83 Do; errors in the determination of the position of the orifice will change only the constant but not this slope. This approach has been tested on a series of orifices using Laser-Doppler and 2D flow mapping with a pulsatile flow model. Four orifices were studied (Do = 5.6, 7.1, 8.2 and 9.8 mm). Various angulations with respect to the orifice were tested. The global regression between Do and the calculated D (Dm) was the following: Dm = 1.6 Do - 4.8, r = 0.96. The results according to the angle were:

Angle	30	45	60	90	120	135	150
Slope	1.79	1.63	1.51	1.37	1.29	1.64	1.71
r	0.96	0.99	0.99	0.99	0.99	0.97	0.98

These various slopes were thought to be the consequence of the hemielliptic shape of PISA close to the orifice. The measurements were repeated at different times during ejection and the measured Dm were found independent of the pulsatility.

In conclusion, the PISA equation can be written in a different format that allows to use a series of velocity measurements and to neglect uncertainties on the position of the orifice. In vitro, this approach is accurate to evaluate the diameter of the regurgitant orifice.

1233 Noninvasive Imaging: Comparison of Different Stress Techniques II

Wednesday, April 1, 1998, 3:00 p.m.–5:00 p.m.
Georgia World Congress Center, West Exhibit Hall Level
Presentation Hour: 3:00 p.m.–4:00 p.m.

1233-143 Adenosine Myocardial SPECT for Detection of Coronary Artery Disease: A Comparison of 3 and 6 Minute Protocols

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Although adenosine (ADEN) myocardial tomography (SPECT) has high accuracy for the detection of coronary artery disease (CAD), ADEN side-effects occur frequently using the standard 6 min infusion protocol. A shorter protocol might decrease the frequency of side-effects and be more cost-effective. The ultra-short half-life of ADEN, coupled with its rapid onset of action, lends support to the use of a shorter protocol. Thus, 316 patients were randomly recruited into a 3 min (n = 177) or a 6 min (n = 139) ADEN infusion protocol. Perfusion tracers were injected at the midpoint of ADEN infusion. There